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PRTN 159

A Proposal for Incremental Routing

Introduction

At our Dec.4, 1975 meeting with Collins and SRI, we suggested a small change to the routing scheme used in the packet radio network. This note documents this proposed scheme, which we agreed to call "incremental routing." We feel that this change is desirable because it decreases the amount of route structure information stored in PRs, hence decreasing the need to update the information; specifically, less relabeling is required. It also simplifies the PRs' route processing slightly, and adds flexibility to the new Collins "dynamic routing" scheme (see below). We do not think the change has any significant drawbacks.

Summary of recently accepted routing methods

All schemes referred to herein are hierarchical in the sense that PRs are assigned to hierarchy levels and communicate directly only with PRs at adjacent levels (we ignore ROPs in this discussion). Packets traverse consecutive levels between a PR and the station PR.

A. NAC's original scheme assigned labels to PRs relative to the single inbound PR they transmitted to. Thus the entire sequence of labels from a PR through the station PR (the whole route) was needed to identify the PR. This scheme
--could accommodate a large number of PRs
--imposed a tree structure on routes

B. Collins' implementation (CAP revision 0) assigned absolute labels to PRs instead of NAC's relative ones. This scheme
--greatly reduced the number of PRs which could be accommodated
--simplified processing
--allowed non-tree-structured route assignment

C. Collins' new implementation (CAP revision 1, dynamic routing) will differ from the above in that the size and location of label fields will not be built into PRs, but will be assigned by the station. This
--allows more PRs than B, assigned to more natural levels, by judicious selection of field sizes
--may allow smaller route fields, hence shorter packet headers

Incremental routing

In all the above schemes, the station gives each PR a level and label (also, in C, a word number and mask to select the corresponding route label field) and a route (sequence of labels) to the station. We propose that instead of a complete route to the station, PRs be given only the label information of the inbound PR they should talk to. That is, a PR would know its own level and label (and word number and mask) and the label (and word number and mask) of its inbound neighbor.

A. Effect on PR program

The PR would have one less word of label info to store -- the next PR's label, word, and mask instead of a 4-word route. This is probably insignificant. (Note that this also reduces RDP text, which contains label, by 1 word.)

Handling of inbound alternate-routed packets would be simplified, since the PR would only fill in the next inbound field (which it explicitly knows where to find) instead of having to fill in the rest of the route (whose location it has to compute). All inbound forwarding would include inserting the next field, so forwarding of alt-routed and non-alt-routed packets would differ less.

B. Effect on dynamic routing

The restriction that the station must assign fields in order (level N field preceding level N+1 field) in routes is removed, because the PR makes no assumptions about the location of fields. It never tries to fill in the "rest" of the route, only references the fields it is explicitly told about (its own and its neighbor's).

C. Effect on route structure

Since each PR forwards packets to a particular inbound PR, route assignments are automatically tree-structured. One might argue that this unnecessarily restricts the ability of the station to assign routes, but this restriction is probably irrelevant. Since all traffic converges towards the station anyway, splitting up streams of traffic on their way there should not improve throughput. In fact, the routing studied and proposed by NAC was tree-structured.

D. Effect on relabeling

Since only single hops are assigned to PRs, less relabeling is required to avoid routing through a failed link. The reason for this is as follows:

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In general, if a link fails then all PRs which route packets through that link need to be relabeled.

In the current scheme, this means that all PRs outbound from the failed link (anywhere further from the station on the same branch of the assigned route structure) must be relabeled. Otherwise, even if the PRs whose links have failed are relabeled, the PRs outbound from them will still be sending packets routed over the failed link.

In the new scheme, only the PR whose inbound hop has failed necessarily (as a direct consequence of the failure) needs relabeling. As long as a relabeled PR stays at the same level, none of its outbound PRs need relabeling. They will still be able to send to it, and their packets will then follow the new route automatically.

Conclusion

This change, like any change to routing, impacts the design of the station labeling program. We believe it removes unnecessary complexity. We request immediate consideration of this change; hopefully it can be included in the forthcoming CAP revision (revision 1).

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